THE

YOUNG MECHANIC.

AUGUST, 1833.

CHEMISTRY.

WATER.

WATER is, by far, more abundant than any other liquid on our globe. It is essential to animal and vegetable life;—and an important agent in promoting the numerous chemical changes which are continually taking place among the works of nature. It was believed by the ancients to be one of the four elements out of which they imagined all other substances were formed; and this opinion maintained its ground for a long time. The composition of water was not ascertained until the year 1781, when it was proved, by McCavendish, to be composed of oxygen and hydrogen, by uniting these substances. This experiment was soon afterwards repeated by numerous other individuals, among them that of Fourcroy, Vauguelin and Seguin, is worthy of particular notice; in this experiment oxygen and hydrogen gases were kept burning for more than a week. The oxygen was prepared from chlorate of potassa and the hydrogen from water decomposed by zinc and sulphuric acid;—both of the gases were passed through caustic alkali before using.

The weight of the hydrogen employed was 1039·358 grains, that of the oxygen 6209·869 gr.; making in all 7249·227 gr. The weight of water obtained was 7244 gr. Upon examination of the water it was found to be as pure as distilled water.

Pure water is transparent, tasteless, colorless, and without odor. According to the parliamentary standard of Great Britain a pint of water weighs 8750 gr. and a cubic inch 252.458 gr. at 62° F. Bar. 30 inches.

Its specific gravity is supposed to be 1000, and it is made the measure of the specific gravity of all other bodies.

'The refractive power of water is very high, owing, as is supposed, to the hydrogen which it contains. By a vigorous stroke in a syringe, water emits a flash of light.—THENARD.

It is a slow conductor of heat. The rapidity with which water may be heated, when heat is applied to the bottom of a vessel containing it, is owing to the interchange, which takes place, among its particles. If heat be applied to the surface of water in a vessel which conducts heat slowly, a long time will be required before the temperature of the water, in the lower part of the vessel, will be altered.

Its combining weight is represented by 9.

According to the results of Dr. Thomson, oxygen gas is 16 times heavier than hydrogen gas, and as water consists of two volumes of hydrogen and one of oxygen, 1 part by weight of hydrogen and 8 parts of oxygen constitute water. Assuming that water is a compound of one atom of hydrogen united with one atom of oxygen, the representative number of hydrogen will be 1, and that of oxygen 8 and 1+8=9 the representative number for water.

It absorbs a portion of every gas. Henry asserts that under additional pressure equal to the atmosphere, twice as much will be absorbed, and under a pressure equal to three atmospheres, three times as much will be absorbed, and so on.

From the atmosphere it absorbs oxygen rather than nitrogen. A quantity of air separated from rain water by boiling, contained about 10 per cent. more oxygen than is contained in the atmosphere. It is to the air which water contains that it owes its agreeable flavor; freed from air it is rendered insipid.

By combination with some bodies water becomes solid. A familiar instance of this is its combination with lime; it is seen also, in numerous crystals. At a temperature of 32° Fah. it becomes ice, and its specific gravity is diminished to about 0·940; the density is dependent, however, upon the temperature at which it formed, and the time required for congelation. It crystallizes in acicular needles, crossing each other at angles of 60 and 120°.

Water, when at the temperature of 42° F. expands in bulk as much for each degree abstracted from, as added to its temperature, provided it be not frozen so that at temperatures of 32° and 52° Fah. its bulk will be the same. By careful cooling, water may be reduced to 22° and remain liquid; but if agitated, instantly congeals. The expansive force of water, during its conversion into ice, has not been accurately ascertained; in the experiment made by Major Williams, at Quebec, bomb shells, thirteen inches in diameter, and more than two inches thick, were burst by filling them with water, and exposing them to a low temperature. In some, the plugs which closed the fuse holes, were thrown to a great distance; one is mentioned, as having been thrown a distance of 415 feet.

Ice, at a low temperature, is hard, tough and elastic; at the celebrated palace of ice constructed by order of the Empress Catharine, cannon formed of it sustained several discharges without bursting.

In warm climates recourse is had to evaporation and radiation for producing ice; for this purpose water is placed in small unglazed earthen vessels, laid upon straw and reeds in shallow pits during calm evenings, when the sky is clear. It may be formed also by placing water in a vessel over sulphuric acid, and removing the atmospheric pressure by the air pump, or more easily by surrounding a vessel of water with a compound of 2 parts sulphuric acid and 2 parts water which has been suffered to cool after mixing, and adding to it 5 parts of sulphate of soda.

According to Dr. Black, 1 pound of ice during its liquefaction absorbs as much caloric as would raise the same quantity of water 140°.

Water boils at a temperature of 212° F., when the barometer is at 30, and is converted into steam, thereby increasing to about 1800 times its former bulk. The boiling point varies with the atmospheric pressure as is shown in the following table:

Barometer.	Boiling point.	Barometer.	Boiling point.
31.	213.76	29	210.19
30.5	212.88	28.5	209 31
30	212	28	208 43
29.5	211.07	27.5	207.55

The elastic force of the vapor of water, measured by the height of the column of quicksilver that it will support, is shown in the following table by Dr. Ure. The temperature is expressed in degrees of Farenheit's scale, and the force in inches of mercury.

24°	0.170	115°	2.820	195°	21.100	242°	53.600	270°	86.300	295 6°	130.400
32	0.200	120	3.300	200	23.600	245	56.340	271.2	88.000	295	129.000
40	0.250	125	3.830	205	25.900	245.8	57.100	273.7	91.200	297.1	133.900
50	0.360	130	4.366	210	28.880	248.5	60.400	275	93.480	298.8	137.400
55	0.416	135	5.070	212	30.000	250	61.900	275.7	94 600	300	139.700
60	0.516	140	5.770	216.6	33.400	251.6	63.500	277.9	97·800	300.6	140.900
65	0.630	145	6.600	220	35.540	254.5	66.700	279.5	101.600	302	144.300
70	0.726	150	7.530	221.6	36.700	255	67.250	280	101.900	303.8	147.700
75	0.860	155	8.500	225	39 110	257.5	69.800	281.8	104.400	305	150.560
80	1.010	160	9.600	226.3	40.100	260	72.300	283.8	107.700	306.8	154.400
85	1.170	165	10.800	230	43.100	260.4	72.800	285.2	112.200	308	157.700
90	1.360	170	12.050	230.5	43.500	262.8	75.900	287.2	114.800	310	161.300
95	1.640	175	13.550	234.5	46.800	264.9	77.900	289	118.200	311.4	164.800
100	1.860	180	15.160	235	47.220	265	78.040	290	120.150	312	167.000
105	2.100	185	16.900	238.5	50.300	267	81.900	292.3	123.100		
110	2.456	190	19.000	240	51.700	269	84.900	294	126.700		

If water be brought in contact with some of the metals heated to redness, the oxygen of the water combines with the metal, and the hydrogen will be set free.* The common process is to fill a green glass, or earthen tube, with clean iron filings, and place the tube

* Iron, zinc, antimony, tin, manganese, potassium, sodium and probably the metalic bases of all the alkaline earths, decompose water.

in a furnace so that both ends may project, having adapted to one end a retort containing water, and to the other a bent tube, leading under a bell glass filled with, and inverted over water, a fire is made in the furnace and the tube heated to redness; the water in the retort is then heated, the steam coming in contact with the heated iron, is deprived of oxygen, and the hydrogen is collected in the bell glass.

Water may be also decomposed by substituting charcoal for iron in the same aparatus, but the hydrogen obtained, will be contaminated by carbonic acid, carbonic oxide, and carburetted hydrogen gases.

For the best process of decomposing water, we are indebted to Messrs. Nicholson and Carlisle, who first discovered the chemical action of the galvanic battery by decomposing water.

If wires of gold or platinum, connected with the poles of a galvanic battery, have their ends placed in a vessel of water, decomposition of the water will immediately commence, and bubbles of gas will be seen forming around the wires. By using two tubes (closed at one end with a cork through which the wire is passed) filled with water, the gases may be collected; the oxygen in the tube connected with the positive, and the hydrogen in the tube connected with the negative pole of the battery.

The most suitable water for chemical operations is rain water. When required for experiments, where acuracy is desired, it should be slowly distilled from glass or silver vessels, preserving the portion which comes over, after about 1-6th has been distilled, and stopping the operation when about three-fourths has passed over.

Water proper to be drank may be distinguished by the following characters: It is perfectly clear, has a lively taste, possesses no odor, and unites with soap without forming lumps. If a solution of nitrate of silver be added, no precipitate will be formed.

To remove the bad qualities of water, several methods are employed. Stagnant waters are set in motion by means of mills, or made to pass through the air by means of jets, cascades, &c. From standing waters the vegetable and animal matters susceptible of putrefaction are removed. The beds of streams which are muddy, are covered with clean sand, or the water is filtered. To separate substances which it holds in solution, boiling is resorted to, sometimes with the addition of a little potash or wood-ashes, and afterwards exposed to the air in shallow vessels. For filtering water, the common filtering stone answers very well, but soon becomes clogged; a vessel with a bottom formed of sponge, closely compressed, answers better and is more easily cleaned. The French make use of cisterns divided into two parts by a partition reaching nearly to the bottom. The part of the cistern into which the water is first conveyed is about half filled with sand, of different degrees of fineness, the finest being at the bottom, through this the water passes clear into the other part of the cistern

[To be Continued.]

GEOMETRY AND ARITHMETIC.

[Continued from page 104.]

CIRCLE.

I ENDEAVORED in my last, to explain the method of finding the ratio of the diameter of a circle to the circumference. It has been found that if the diameter be 1, the circumference will be 3·1416; and if one be doubled, the other will be doubled also; or, if one be increased tenfold, the other will be increased tenfold, &c. both increasing or diminishing in the same ratio; so that to find the circumference of a circle when the diameter is given, it is only necessary to increase (3·1416) the circumference of unity, as many times as the diameter contains unity; or, multiply 3·1416 by the diameter and the product will be the circumference. Thus, if the diameter be 8, the circumference will be 25·1328. It is shown geometrically at page 89, that the area of a circle is found by multiplying half the diameter by half the circumference. Having found the ratio between the diameter and circumference, we may now find the area itself. Suppose it be required to find the area of a circle whose diameter is 1, and circumference 3·1416. We must multiply the half of 1, which is ·5, by the half of 3·1416, which is 1·5708.

Thus 1·5708 half the circumference.
Multiplied by ·5 half the diameter.

Gives ·78540 the area.

With the area (0·7854) of a circle whose diameter is 1, we may find the area of any other circle from the diameter, without knowing what the circumference is; for the areas of circles increase or diminish, as the squares of their diameters increase or diminish, (see page 43.) Hence if 0·7854 be multiplied by the square of the diameter, the product will be the area. Suppose the diameter to be 2, the square of 2 is 4; and 4 times 0·7854 is 3·1416 the area of a circle whose diameter is 2. To make this more clear, let us analyze the process. Take a circle whose diameter is one inch, its area will be one circular inch, or 0·7854 parts of a square inch; that is, if a square inch be divided into ten thousand parts, a circular inch will contain or be equivalent to 7854 of those parts. By squaring the diameter, we get the number of circular inches contained in the circle; and by multiplying these circular inches by 0·7854 we reduce them to square inches.

It will be well for those who wish to pursue this subject, to commit the two numbers 3·1416 and 0·7854 to memory, they are called factors, and are expressed decimally; but I am afraid many

of our young mechanics are not sufficiently acquainted with decimals, to enable them to take that interest in this very useful subject that they otherwise would; for whose benefit before I proceed further, I will give a brief explanation of decimal fractions; and then point out other useful factors, with their applications.

PHILO.

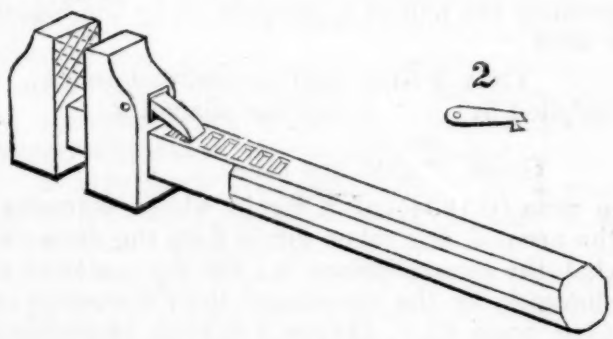
Philadelphia, May 18th, 1833.

DESCRIPTION OF A NEW RACK WRENCH*.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—In reading over the list of patents in the April number of the Journal of the Institute, I was struck with the great similarity of a rack wrench, patented by Mr. King, (see page 240,) with one invented by me, and made eighteen months ago. In the first plan which occurred to me, I intended to employ a spring to keep the click of the wrench in its place, but I preferred not to use it on account of its liability to get out of order.

Fig. 1.



The form of the click is shown in the figure accompanying; it is simple, and answers every purpose. The figure is drawn to the full size of the wrench in my possession; it is made of iron case hardened, with the exception of the click, which is of cast steel. The wrench has now been in use eighteen months, and its good qualities have been tested by strains of considerable amount.

Fig. 1 represents the wrench, and fig. 2 is the click which is shown in its place in fig. 1. They are one-fifth the full size. —[*Journal of the Franklin Institute.*

* Invented by Mr. Alfred C. Jones, steam engineer. For an account of Mr. King's patent, see Young Mechanic page 99.

EXCELLENCE NOT LIMITED BY STATION.

THERE is not a more common error of self-deception than a habit of considering our stations in life so ill-suited to our powers as to be unworthy of calling out a full and proper exercise of our virtues and talents.

As society is constituted, there cannot be *many* employments which demand very brilliant talents, or great delicacy of taste, for their proper discharge. The great bulk of society is composed of plain, plodding men, who move 'right onwards' to the sober duties of their calling. At the same time the universal good demands that those whom Nature has greatly endowed should be called from the more ordinary track to take up higher and more ennobling duties. England, happily for us, is full of bright examples of the greatest men raised from the meanest situations; and the education which England is now beginning to bestow upon her children will multiply these examples. But a partial and incomplete diffusion of knowledge will also multiply the victims of that evil principle which postpones the discharge of present and immediate duties, for the anticipations of some destiny above the labors of a handicraftsman, or the calculations of a shop-keeper. Years and experience, which afford us the opportunity of comparing our own powers with those of others, will, it is true, correct the inconsistent expectations which arise from a want of capacity to set the right value on ourselves. But the wisdom thus gained may come too late. The object of desire may be found decidedly unattainable, and existence is then wasted in a sluggish contempt of present duties; the spirit is broken; the temper is soured; habits of misanthropy and personal neglect creep on; and life eventually becomes a tedious and miserable pilgrimage of never-satisfied desires. Youth, however, is happily not without its guide, if it will take a warning from example. Of the highly gifted men whose abandonment of their humble calling has been the apparent beginning of a distinguished career, we do not recollect an instance of one who did not pursue that humble calling with credit and success until the occasion presented itself for exhibiting those superior powers which Nature occasionally bestows. Benjamin Franklin was as valuable to his master, as a printer's apprentice, as he was to his country as a statesman and a negotiator, or to the world as a philosopher. Had he not been so, indeed, it may be doubted whether he ever would have taken his rank among the first statesmen and philosophers of his time. One of the great secrets of advancing in life is to be ready to take advantage of those opportunities which, if a man really possesses superior abilities, are sure to present themselves some time or other. As the poet expresses it, 'There is a *tide* in the affairs of men,'—an ebbing and flowing of the unstable element on which they are born,

—and if this be only 'taken at the flood,' the 'full sea' is gained on which 'the voyage of their life' may be made with ease and the prospect of a happy issue.

But we should remember, that, for those who are not *ready* to embark at the moment when their tide is at its flood, that tide may never serve again; and nothing is more likely to be a hindrance at such a moment than the distress which is certain to follow a neglect of our ordinary business.—[*Mechanics' Magazine.*

For the Young Mechanic.

AMPHIBIOUS STEAMER.

THE amazing success with which steam has of late been applied, both on land and water, surpasses the most sanguine expectations of the mechanical student; and almost realizes the imaginations of the poet, who says,

> 'Soon shall thy arm, unconquer'd steam! afar
> Drag the slow barge, or drive the rapid car;
> Or, on wide waving wings expanded bear
> The flying chariot through the fields of air.'

But before we are prepared to mount into the air, by the force of steam, it will be necessary to make another improvement, so as to unite the steam boat and steam carriage in one machine, that will be capable of travelling on both land and water. I believe this can be done on a small scale, for pleasure if not for profit. A boat can be made light enough to answer for the body of a carriage, and yet strong enough to bear a little beating about at sea. At least, it would do to cross a pond or small lake, and perhaps a river whose current is not very rapid. It will be necessary to have wheels to run on the ground, which may serve also for paddle wheels, or what would be still better, it might have separate paddle wheels similar to those in common use. The ends of the boat must be turned up, so as to enable it to pass in and out of the water without wetting the deck.

Having faintly described this new steamer, let us now imagine a little excursion with it. Suppose all the passengers safely on board, and she starts from some central part of the city; and enter the bay by a gently inclined road. Very soon after the fore part of the boat touches the water, the fore wheels will leave the inclined plane; and when she is afloat, the paddle wheels may be set in motion. (In crossing some rivers, velocity enough may be given in descending, to drive her across to the inclined plane on the opposite side without the use of paddle wheels.) We may now visit the islands in the bay, catch a few fish, and afterwards proceed to Nahant, or pass up the beach at some suitable place, and return by land, crossing the ferry from Chelsea, to the place from whence we started. PHILO.

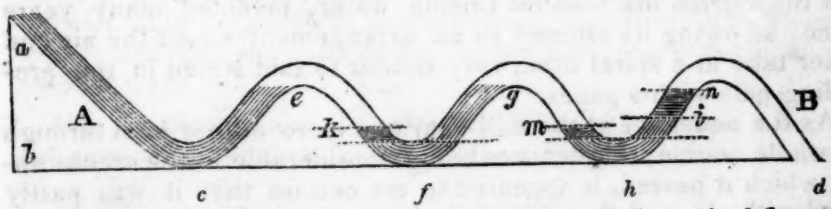
WATER IN PIPES OBSTRUCTED BY AIR.

An account of the Passage of Water through an Aqueduct being totally obstructed by collections of Air; and on the Equilibrium of different fluids in bent tubes. By D. TREADWELL.

A LEAD pipe, having a bore an inch and a half in diameter, was laid from a well in Roxbury to the mills at the water works on the Boston mill-dam for the purpose of supplying the workmen, who carry on the various manufactories erected on the mill-dam, and their families, with fresh water. The surface of the water in the well was found by a survey to be somewhat higher than any of the ground through which the aqueduct passed. The whole length of the aqueduct was about 6000 feet, and its general course was through a salt marsh; in its way, however, it passed under the bed of two creeks, which may be taken at 12 feet deep, each, and near its termination it descended from the marsh to the bed of the bay, on which the mill-dam is built. It was laid about three feet beneath the surface of the marsh, and opened into a reservoir at the city mills four feet below the level of the surface of the water in the fountain well.

After completing the aqueduct and opening it into the well, it was found that not a drop of water would run through it. As it was known that there were no mechanical obstructions in the pipe, it was thought not a little anomalous that the water should not pass through it.

In this state of things I was requested by those interested in the aqueduct, to consider the circumstances, and endeavor to procure a passage of the water. When the exact condition of the aqueduct was taken into consideration, I perceived that the water let into it might have made such an arrangement, in relation to the air with which the pipe was previously full, as to obstruct wholly its passage. For let us suppose in the annexed figure, A B to represent a pipe open throughout its length, but its



sides being perfectly tight, and having the several vertical flexures here represented, and let it be required to pass water, or any heavy fluid, through it in the direction from A to B, the end A being elevated the distance *a b* above B, *c d* being a horizontal line. It is evident that the water being let into the end at *a* will pass and fill the pipe to *e*, displacing all the air with which the pipe, being open to the atmosphere, was previously full. Flowing

over the curvature *e* in a stream or column less than the bore of the pipe, it fills the curvature at *f* without displacing the air previously contained in the descending section from *e* to *f*. This air is thus shut up, and cannot pass from the pipe in any direction without passing under the water, which, from its inferior specific gravity is impossible. The water, continuing to flow over the flexure *e*, rises from *f* to *g*, and flowing over this flexure the same thing is repeated, as to the air from *g* to *h*, which took place at the flexures *e* and *f*. Rising from *h* until it attains some point, *i* for example, at which the sum of the perpendicular heights of the ascending columns *c e*, *f g*, &c. is equal to the height of the column *a b*. That is, if we suppose the air to be un-elastic and void of weight, but as this is not true in fact, the air will be condensed in a greater or less degree according to its volume and the height of the columns of water opposed to it. In consequence of this condensation, the water will rise, as shown in the figure, to *k* and *m* for example, and the weight of these columns being added to the effective force of the column *a b*, produces a rise of the water to some point, *n*, in the flexure *h n*. There is then a perfect equilibrium in the opposing forces, and the water can flow no farther. This equilibrium may be expressed generally by

$$a\ b + c\ d = b\ e$$

in which *a* is the perpendicular height of the water in all the descending flexures ; *b* its density ; *c* the perpendicular height of all the inclosed air ; *d* its mean density ; and *e* the perpendicular height of all the ascending columns of water.

Several writers on Hydrodynamics have noticed the obstruction which air often presents to the passage of water in bent tubes ; but in the works that I have had an opportunity of consulting, the authors appear to regard the air as collecting in the high parts of the tube, and partially closing its bore, thus diminishing without totally obstructing the discharge. This is quite different from the effect of the arrangement which I have attempted to explain.—Those, however, who are acquainted with this subject will recollect the Zurich machine for raising water, invented many years since, as owing its efficacy to an arrangement which the air and water take in a spiral tube, very similar to that stated in the preceding part of this paper.

As the aqueduct at the mill-dam was more or less bent through its whole course, the flexures being considerable at the creeks under which it passed, it appeared to me certain that it was partly filled with air, and that this alone interrupted the flow of water. On opening small holes into it in several places, air rushed out in great quantity; still, however, the water did not flow at the reservoir, and as it was impossible to get at the bendings in every part of the pipe without the labor of uncovering it wholly, the design of freeing it from air by piercing it with small holes was suspended. A forcing pump was then coupled to the upper end of the pipe, and water, which had been heated in the worm tube of a distil house, in the vicinity, was forced into it. The pump was furnished

with a valve loaded with a weight equal to a column of water 80 feet high, and a very small opening made from the aqueduct into the reservoir at the mills, so that the water passing slowly through the whole length of the aqueduct was there discharged. The object of this apparatus was to produce an absorption of the air by bringing it in contact, under heavy pressure, with water which had parted with some of its air by being heated; as these conditions are known to be favorable to the absorption of air by water. The pumping was continued about ten days, and the quantity of water used may be taken at 20 hogsheads ; when the pump was taken off, and the aqueduct opened into the fountain. The water was then found to flow at the reservoir, discharging as much as was due to the head. This discharge has continued uninterruptedly to the present time, about five months. There can be no doubt but much air was absorbed, its presence in the aqueduct being indicated, when the pumping was commenced, by its throwing a stream of water out of the pipe, on which the loaded valve was placed, whenever the weight was removed from the valve. The quantity of water thus thrown back was much too great to have been produced from the elasticity of the water or the lead pipe, and it diminished daily, having almost ceased before the pump was taken off.—[*Boston Journal.*

PATENTS FOR MASSACHUSETTS.

Granted in December, 1832.

From the Journal of the Franklin Institute.

For an improvement in the *Machine for preparing Cotton Roving;* John A. Bradshaw, Foxborough, Norfolk county, Massachusetts, December 8.

Without the drawings we cannot give a clear idea of the proposed novelty, which consists in the application of a spring to the flyer, in such a way, and so constructed, as to give a slight degree of twist and condensation to the roving; a purpose which persons acquainted with the subject are aware has been accomplished in various ways.

For the *Application of Cork to the filling of Beds*, and other useful purposes; Stephen Bates, Boston, Massachusetts, December 25.

The cork is to be first dried, and then ground, or grated, to reduce it into pieces the size of a walnut, and smaller. When so prepared it is to be used for all the purposes of stuffing to which feathers, wool, hair, &c. are applied. Beds, mattresses, and pillows, so stuffed will, we are told, serve the purpose of life preservers, in case of disaster in steam-boats, and other vessels.

For a *Vertical tortive wire door spring;* John Codman, Boston, Massachusetts, December 28.

The point, or part, claimed in the specification of this patent, is not that which the title would indicate; and that part of the apparatus which is claimed as new, is described in such a way as would seem to confine the inventor to the exact form and arrangement given by him. The door spring is to consist of a piece of wire about twice as long as the height of the door. This wire is to be doubled, leaving a loop at one end, which may be hooked upon a metallic plate screwed on to the door, near its bottom, and to the hinged joint. The wires are to be lightly twisted together, making one turn round each other in about a foot. An apparatus, called the graduator, is to be fastened on to the door casing, just above the hinge joint of the door. Into a wheel having teeth upon a projecting rim, formed in the manner of a crown wheel, the two ends of the wire are to be secured, about five-eighths of an inch apart. When the wheel is turned upon its centre pin as it stands horizontally, the twist of the wires will be thereby regulated. The teeth surrounding the wheel are to receive a pin to retain it in any required position. The claim is to 'the regulating box, and the teeth and groove of the regulator, and the application of them.'

The thing to be effected is so simple, and the modes in which it may be done so numerous, and some of them so much less complex than the one proposed, that a claim so restricted appears to be of little value.

For a *Machine for pressing Straw and other Hats;* Otis Plimpton, Foxborough, Massachusetts, December 28.

The apparatus here described consists, in part, of a suitable block, fixed to the frame work of the machine, and upon which the hat is to be placed when pressed, which is done by a heated flat iron; to this a horizontal motion is given by a shaft carrying an eccentric, which acts upon a lever, to the opposite end of which the pressing iron is attached. By placing the foot upon a treadle, the pressure may be regulated in any required degree. There are a number of different contrivances for throwing the machine in and out of gear, and for other purposes, which cannot be shown without the drawing.

For an improvement in the *Machine for Ruling Paper;* Alfred Hathaway, Troy, Bristol county, Massachusetts, December 31.

It is intended, when necessary, to rule the paper on both sides by placing it once on this machine; we cannot without the drawings give a good idea of its construction, and even with them it is not easy to trace the particular operation and arrangement of some of its essential parts; the description not being sufficiently in detail.

The claims made are to 'the ruling both sides of paper at one operation. The application of the motion to the machine, and the general arrangement of the machine, and the operating of it by one person. The peculiar construction of the pens. The application of the pens to the top of the cylinder.'

STONE-SPLITTING SCREWS.

The following extract is from the London Mechanics' Magazine; by which it appears, that Mr. Robert Mallet has succeeded in using the screw instead of gunpowder, for splitting rocks. He has tried it with success on slate, and the softer kinds of stone; but whether it will answer for the harder kinds, remains to be proved. If this invention should be extensively adopted, it may be the saving of many lives and limbs.

Sir,—Some time since, while visiting the Bangor slate quarries, I was struck with the enormous waste of materials, arising from the mode adopted of shaking down large masses of slate to be afterwards split into roofing slates. The strata lie nearly vertical, and by every blast that is fired many tons of slate are shivered to atoms and made useless.

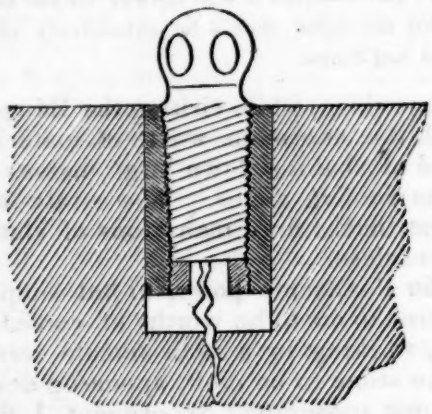
As a remedy for this, some powerful but simple application of the wedge appeared to me to be worthy of consideration. A conical male screw, working in a split female screw, placed in a jumper hole in the stone to be cleft, appeared one of the best that occurred; and, upon subsequent experiment, I find it to exceed my expectations, both for splitting, roofing, slate-work, and all other stones.

The screw which I had made as an experimental one, is about nine inches long in the screw, and two inches diameter at the lower end, and two inches and an eighth at the upper. It has a round thread, of as strong a form as possible, and a proper eye at the top for the insertion of a lever. The two segments of a cylindrical shell, which form its nut or box, are each one-fourth the circumference of a complete cylinder, and half an inch in thickness; thus the jumper hole for this screw requires to be three inches diameter and nine inches deep.

The screw is made of iron, sheathed with steel like a tap, and hardened; and the box segments are made of cast iron, poured in an iron mould, which makes the screw threads very perfectly and cheaply; their brittleness and hardness are afterwards corrected by annealing. They alone are injured in the operation of splitting, and by this way of making them, are easily replaced.

Now, I am fully aware of the objections that may be urged, of a conical screw being applied to a cylindrical one, and of the threads of a conical screw making variable angles with the axis; but the taper or angle of the cone requires to be but very small, being determined by the modulus of elasticity of the stone to be split, which in all rocks commonly met with is very low; so that the screw being very coarse—having round threads, being very little taper, and not requiring to fit accurately—those objections are not cogent.

To use this apparatus, the jumper hole being prepared, the two segments are placed at opposite sides of it, and the screw inserted and screwed down. The friction of the stone against the back of the segments keeps them in their respective places. The screw must descend, and as it descends it must expand the segments, and by their expansion the stone is split. I have found by exper-



iment that the rock will always split in the direction of the interval between the segments; so that when a prolonged section of an homogeneous rock is required, it is easily produced by a number of such screws placed in the desired line. Omitting the consideration of the effects of friction, which, I am fully aware, are in this case very considerable, but can only be determined by experiments, it is sufficiently obvious that the power of this instrument is the same as that of a wedge employed for cleaving, whose angle is equal to that of the cone round which the screw is wrapped, urged, or driven on by the energy due to the same screw, actuated by a lever of a given length.

The power of this screw, then, is expressed by

$$P = \frac{h}{2\pi R} W.$$

where P is the power or energy of the screw; h the distance between two contiguous threads; π the constant ratio of the diameter of a circle to its circumference; R the length of the lever used; and W the power or dead weight applied.

The power of the wedge, again, is given by the equation,

$$P = \frac{R\, l\, B}{L^2}$$

P representing the energy with which the power of the screw acts against the resistance of the particles of the stone, the length from the point or extremity of the cleft or split when *first commenced*, to

that point where the resistance may be supposed concentrated against the sides of the wedge, *i. e.* the screw segments; and L the length of the cleft when first commenced. It is obvious, that R, *l*, and L, vary with different kinds of stone, and are constant with each particular kind; whence, for want of experimental data, it is impossible at present to reduce these equations to figures.—The friction, too, of the instrument increases in a greater ratio than the pressure, from the continually increasing difference between the threads of the conical male screw and those of the cylindrical female screw.

So far, it will be admitted, I have not slurred over the difficulties and disadvantages to which the machine is exposed; but I have tried it, and the result of one experiment, at which the whole of the Commissioners of Public Works in this county, Mr. Vignoles, the engineer, of Liverpool, and Mr. John M'Mahon, of the firm of Henry Mullens & M'Mahon, were present, and expressed their entire satisfaction, will suffice.

Two men, with a lever of only *three feet in length*, and a single screw and segments of the size before described, split a mass of the argillaceous lime-stone of the county of Dublin, (*Calp* of Kirwan,) weighing nearly a ton, in 17 revolutions of the screw, made in about 25 or 30 sec. The men did not put forth their strength, but merely walked round the stone, which was split contrary to its stratification, and exactly in the line of separation of the segments. The sufficiency of the power is thus clearly shown.

Mr. John M'Mahon has informed me by note, that 'he considers it a very great improvement in the art of quarrying.'

This instrument is more particularly applicable to slate quarrying, and for the purpose of obtaining great tabular masses of granite, sienite, or other very hard and homogeneous rocks. In the former application, the saving of slate, and of labor in clearing the *face* of slate-rock of the accumulating rubbish shook down by the method of blasting, recommend it. In the latter, the saving of labor, the certainty of the direction of the fracture, and the capability of splitting larger blocks than have been as yet attempted by wedges. It may be also applied to raising stratified rocks from their beds, and as a substitute for blasting in general. The jumper holes usually used for the granite of this county are three inches in diameter, and sometimes *sixteen feet* deep. Each of these screws only requires a jumper hole of nine inches deep, and three inches diameter, and *no gunpowder;* and it is hardly questionable but that 20 of these screws, requiring *less* labor of preparation, would produce a greater effect than the one blast, besides producing it in a predetermined direction.

There is another advantage of these screws over blasting, that they are free from danger to the workmen employed in using them. There is but one way that I am aware of in which it is possible for them to fail, namely, by the threads of the screw splitting off; but

the force required to strip a steel screw of one-fourth of an inch round thread, in depth and width, when twelve or fourteen threads are engaged at once, is enormous; and when a number of screws are in action on one mass of rock, the force on any individual screw need not be great.

The first cost of such screws is not very great. The male or conical screws, being of hardened steel, will last a long time; and the segments are cheaply made, when once the mould is prepared, as they wear out or are broken. The cost of jumpers is less than for blasting purposes, as they are so much shorter. It is obvious, also, that these screws may be applied at the bottom of a fissure or jumper hole, as well as near the surface of the rock, by having the head of the screw properly prolonged

Oil and black lead should be used to lubricate the screw during its descent. If a cast iron segment should break in the hole during the descent of the screw, it does not matter, as the pieces are still held by friction in their relative situations. The saving in gunpowder and labor alone, in such a place as the Bangor slate quarries, would pay the cost of some thousands of these screws, should they be found to succeed, in a few months I should suppose.

QUESTION.

It is said that the turning gates of the Dry-Dock sustain a pressure at high water of 800 tons. I would ask some of your correspondents how this pressure is calculated; whether we measure back from the gates one, two, three, four or five feet, or whether we take the whole extent of the ocean.